ESTIMATING INTERNAL TRANSACTION COSTS: CASE OF DAIRY CORPORATE FARMS IN MOSCOW OBLAST OF RUSSIA

NIKOLAY SVETLOV*

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1 INTRODUCTION

Many authors, e.g. (Liefert et al., 2003), Lerman (2001), Uzun (2005), mention harm to the transitional process in Russian agriculture caused by high transaction costs. However, there are only few studies that attempt to quantify transaction costs. One example is a case study (Shagaida, 2007) based on direct observation of agricultural land transactions. All costs and losses emerging during this process are accounted. Shagaida concludes that high transaction costs on agricultural land market are caused by actions of federal government and unlikely to be decreased at the farm level. However, that study is only conducted in a limited number of farms.

This paper introduces a non-parametric econometric framework that allows estimating internal transaction costs. It makes use of a linear programming model representing technology available to sample farms like in data envelopment analysis (DEA) methodology.

Many authors, e.g. (Kantarelis, 2007), (Dietrich, 1994), expand understanding of transaction costs from original Williamson's 'costs of using price mechanism' to the costs of information gathering, negotiation, monitoring and enforcement, which appear both inside and outside a firm.

External transaction costs include costs of seeking a partner in the market, which could pay or receive the best price, contracting and enforcement costs. They are assumed to take a smaller share in overall costs when sales are larger. *Internal* transaction costs limit capability of decision making units to react to price signals.

* Moscow Timiryazev Agricultural Academy (MTAA), Russian Federation.
E-mail: svetlov@timacad.ru

In presence of transaction costs competitive market equilibrium is not necessarily the most desirable state for all participants of the market. In other words, prices do not help allocating resources optimally. As a consequence, high transaction costs diminish the advantages of market economy. Exploring transaction costs could explain why the results of agricultural reform in Russia are limited.

This paper aims at testing presence of high transaction costs on dairy corporate farms located in Moscow oblast, limiting the scope of the study to internal transaction costs only. The research focuses on development of the relevant methodological framework, estimating the level of internal transaction costs on the studied farms, and approaching cause-and-effect relations of transaction costs.

2 THEORETICAL FRAMEWORK

Let $\mathbf{x}$ be a non-negative input vector, $\mathbf{y}$ - a non-negative output vector, $\mathbf{v}$ - a non-negative input price vector, $\mathbf{w}$ - a non-negative output price vector, $\mathbf{f}(\mathbf{x})$ - a multi-component (vector) production function of a firm. Assume that the market is not perfect in the sense that it is not the market of one price, so price vectors consist of the best commodity prices that are accessible to the particular decision maker.

Under standard neo-classic assumptions about a firm (Kantarelis, 2007) an optimal netput allocation is obtained from the mathematical problem

$$\max_{\mathbf{x},\mathbf{y}}(\mathbf{wy} - \mathbf{vx} \mid \mathbf{y} \le \mathbf{f}(\mathbf{x})). \qquad (1)$$

To allow for technical inefficiencies that are out of the control of the firm (like accidental breakdowns), this specification can be rewritten as

$$\max_{\mathbf{x},\mathbf{y}}(\mathbf{wy} - \mathbf{vx} \mid \mathbf{y} \le \alpha\mathbf{f}(\mathbf{x})), \qquad (2)$$

where $\alpha \in [0, 1]$ is a technical efficiency score. If a firm is technically efficient then $\alpha = 1$, so (2) is identical to (1). Hereafter $(\mathbf{x}_0, \mathbf{y}_0)$ denotes the netput allocation optimal with respect to problem (2).

Suppose that search for optimal netput allocation is costly and nature of these costs is outside inputs represented by $\mathbf{x}$ (in other words, accruing these costs does not imply changing $\mathbf{x}$). These costs can be expressed in a form of internal transaction costs function $t(\mathbf{x}, \mathbf{y})$. This function is assumed to be continuous, non-negative, having a unique zero in $(\mathbf{x}_0, \mathbf{y}_0)$ and strictly increasing on increase of any distance

$$|x_k - x_{0k}|, |y_l - y_{0l}| \quad (3)$$

such that $\mathbf{x}_0 = (x_{0k})$, $\mathbf{x} = (x_k)$, $\mathbf{y}_0 = (y_{0l})$, $\mathbf{y} = (y_l)$.

Rational behaviour in presence of costs $t(\mathbf{x}, \mathbf{y})$ is defined by the mathematical programme

$$\max_{\mathbf{x},\mathbf{y}}(\mathbf{wy} - \mathbf{vx} - t(\mathbf{x}, \mathbf{y}) \mid \mathbf{y} \le \alpha\mathbf{f}(\mathbf{x})). \quad (4)$$

Given this, the optimal netput pair $(\mathbf{x}_1, \mathbf{y}_1)$ exists such that the costs $t(\mathbf{x}_1, \mathbf{y}_1)$ associated with a shift from $(\mathbf{x}_1, \mathbf{y}_1)$ towards $(\mathbf{x}_0, \mathbf{y}_0)$ are no longer repaid with increment of $(\mathbf{wy} - \mathbf{vx})$.

None of the assumptions requires that the optimal solution $(\mathbf{x}_1, \mathbf{y}_1)$ of the problem (4) would be unique. Let profit function derived from (2), which reaches a maximum in $(\mathbf{x}_0, \mathbf{y}_0)$, and internal transaction costs function $t(\mathbf{x}, \mathbf{y})$, which reaches a minimum at the same point, be convex and monotonous. Then the place for the optimal solutions of (4) in $(\mathbf{x}, \mathbf{y})$-space, if exists, is either $(\mathbf{x}_0, \mathbf{y}_0)$ or a closed curve around $(\mathbf{x}_0, \mathbf{y}_0)$. A firm outside this curve will keep seeking better netput allocation, meanwhile a firm inside it must be happy with its current netput allocation.

In practice $t(\mathbf{x}, \mathbf{y})$ is unknown. However, the assumption that (4) is a true model of a firm implies that the observed netput vector $(\mathbf{x}_2, \mathbf{y}_2)$ of the firm is:

a) either equal to $(\mathbf{x}_1, \mathbf{y}_1)$;

b) or a point of a segment from $(\mathbf{x}_1, \mathbf{y}_1)$ to $(\mathbf{x}_0, \mathbf{y}_0)$.

In both cases $(\mathbf{x}_2, \mathbf{y}_2)$ is fixed in the sense that the firm has no motivation to change it. This can be used to recover the properties of the unknown $t(\mathbf{x}, \mathbf{y})$ that are consistent with the observed $(\mathbf{x}_2, \mathbf{y}_2)$.

First we need to examine the case (a). Consider the problem

$$\max_{\mathbf{x},\mathbf{y},\alpha} (\mathbf{wy} - \mathbf{vx} \mid \mathbf{y} \le \mathbf{f}(\mathbf{x}_1), \mathbf{x}_1 = \mathbf{x}, \alpha\mathbf{y} = \mathbf{y}_1). \quad (5)$$

By composition, its optimum in $(\mathbf{x}, \mathbf{y})$-space matches the optimum $(\mathbf{x}_1, \mathbf{y}_1)$ of problem (4). Hence, there exists a non-empty class of $t(\mathbf{x}, \mathbf{y})$ such that any member of this class makes $(\mathbf{x}_1, \mathbf{y}_1)$ be an optimum of the corresponding problem (4). The property of $t(\mathbf{x}, \mathbf{y})$ that is necessary to belong to this class can be derived from Kuhn-Tucker conditions of both problems (4) and (5) in $(\mathbf{x}_1, \mathbf{y}_1)$. This property is the following:

$$\frac{\partial t(\mathbf{x},\mathbf{y})}{\partial x_k} = \frac{\partial \lambda_k (x_k - x_{1k})}{\partial x_k} \forall k, \qquad \frac{\partial t(\mathbf{x},\mathbf{y})}{\partial y_l} = \frac{\partial \mu_l (\alpha y_l - y_{1l})}{\partial y_l} \forall l, \quad (6)$$

assuming $\mathbf{x} = (x_k)$, $\mathbf{y} = (y_l)$, $\mathbf{x}_1 = (x_{1k})$ and $\mathbf{y}_1 = (y_{1l})$; λ_k is a Lagrange multiplier of the constraint $x_l - x_{1l} = 0$ and μ_l is a Lagrange multiplier of the constraint $\alpha y_l - y_{1l} = 0$. From (6) it follows that $\partial t(\mathbf{x}_1, \mathbf{y}_1)/\partial x_k = \lambda_k \; \forall k$ and $\partial t(\mathbf{x}_1, \mathbf{y}_1)/\partial y_l = \mu_l \; \forall l$.

So, given the following:

- A firm behaves in accordance to problem (4);
- $t(\mathbf{x}, \mathbf{y})$ is unknown;
- $\mathbf{f}(\mathbf{x})$ is known;
- $\mathbf{x}_1$ and $\mathbf{y}_1$ are observable,

it is possible to estimate $\partial t_i(\mathbf{x}_1, \mathbf{y}_1)/\partial x_k$ and $\partial t_i(\mathbf{x}_1, \mathbf{y}_1)/\partial y_l$ that characterize local properties of the unknown $t(\mathbf{x}, \mathbf{y})$ at the point $(\mathbf{x}_1, \mathbf{y}_1)$. To perform the estimation one should derive Lagrange multipliers from (5) by the instrumentality of any numerical mathematical programming application.

These values are measured in monetary units per unit of a netput, just like prices. Since they are only valid in an infinitely small vicinity of $(\mathbf{x}_1, \mathbf{y}_1)$, they do not allow measuring gross transaction costs. However, they make it possible to compare:

- relative burden of internal transaction costs in different firms;
- relative impact of internal transaction costs on allocation of particular inputs or outputs;
- internal transaction costs versus commodity prices.

Analysis of case (b) gains from the assumptions that both profit function derived from (2) and $t(\mathbf{x}, \mathbf{y})$ are convex and monotonous. Under these assumptions the following inequalities take place: $\partial t(\mathbf{x}_1, \mathbf{y}_1)/\partial x_k \ge \lambda_k \; \forall k$ and $\partial t(\mathbf{x}_1, \mathbf{y}_1)/\partial y_l \ge \mu_l \; \forall l$. So, in case (b) the Lagrange multipliers λ_k and μ_l inform only about the lower estimate of the transaction cost function derivative. However, this value is still of interest for many applications, as it allows classifying internal transaction costs as 'definitely high' when these Lagrangean multipliers are large in comparison to corresponding netput prices.

This theoretical framework has two important limitations.

First, in practice the problem (5) may appear to be degenerate so that values of λ_k and μ_l appear to be infinite (within some range). In this case this problem is not sufficiently informative about the sought properties of internal transaction costs function. This obstacle is not crucial when the degeneracy appears only in a few cases of the studied sample. Otherwise it can make the approach useless. The control over the degeneracy is necessary in the empirical specifications.

Second, the approach rests on the property of $t(\mathbf{x}, \mathbf{y})$ that is necessary for matching optima of problems (4) and (5). In general, it is possible that optima do not match in presence of the necessary property of $t(\mathbf{x}, \mathbf{y})$ if either profit function or $t(\mathbf{x}, \mathbf{y})$ are not strictly convex. This limitation is conditional for any empirical specification of (5).

3 EMPIRICAL SPECIFICATION AND DATA

To access the internal transaction costs on Moscow oblast dairy farms, a linear specification of problem (5) is used. Production function $\mathbf{f}(\mathbf{x})$ is specified using a widespread data envelopment approach (Charnes, 1994). The result is the following linear problem:

$$\max_{\alpha,\mathbf{в},\mathbf{y}} \mathbf{w}_n\mathbf{y} - \mathbf{v}_n\mathbf{x}_n$$
$$\begin{cases} \mathbf{y}_n = \mathbf{Y}\mathbf{в},\ \mathbf{x}_n \geq \mathbf{X}\mathbf{в},\ \mathbf{y} = \dfrac{1}{\alpha}\mathbf{y}_n \\ \mathbf{i}\mathbf{в} = 1 \\ 0 \leq \alpha \leq 1, \mathbf{в} \geq \mathbf{0}. \end{cases} \quad (7)$$

Here $\mathbf{x}_n$ and $\mathbf{y}_n$ are non-negative vectors of actually observed annual inputs and outputs of farm n; $\mathbf{v}_n$ and $\mathbf{w}_n$ are the corresponding farm-specific prices; $\mathbf{X} = (\mathbf{x}_n)\ \forall n$; $\mathbf{Y} = (\mathbf{y}_n)\ \forall n$; $\mathbf{y}$ is a non-negative vector of modeled outputs; α is a technical efficiency score if the production is unprofitable or 1 otherwise; $\boldsymbol{\beta} = (\beta_n)\ \forall n$ is a non-negative vector of variable weights associated with each netput pair $(\mathbf{x}_\text{n}, \mathbf{y}_n)$.

The difference between $\mathbf{y}_n$ and technically optimal value $(1/\alpha)\mathbf{y}_n$ is presumed to have accidental nature. So, it should not be taken into account as evidence of internal transaction costs. For

this purpose, variable α absorbs the impact of technical inefficiency on actually observed $\mathbf{y}_n$. Constraint $\mathbf{y} = (1/\alpha)\mathbf{y}_n$ implements the condition $\alpha\mathbf{y} = \mathbf{y}_1$ in theoretical model (5). Hence, the reduced costs of its components, which correspond to μ_l, estimate internal transaction costs per unit of corresponding output.

The linear programme that is conventionally used in data envelopment analysis for the purpose of accessing technical efficiency scores maximizes α. The specific feature of (7) is a monetary objective function, as it is required by (5). This feature makes it necessary to explicitly constrain α to be no greater than one. Presence of this constraint implies that in case of losses a farm does not avoid them due to presence of internal transaction costs.

The particular benefit of DEA-like specification is that, due to its numerous variables, it diminishes the risk that the linear programme would appear to be degenerate.

In this study the components of vector $\mathbf{y}$ are as follows: dairy milk, animal output excluding milk, crop output. Only sales are reckoned as outputs, intermediate products are not taken into consideration. Vector $\mathbf{x}$ consists of arable land, hayland and grassland, number of agricultural workers, depreciation as a proxy for fixed production assets, short-term production costs as a proxy for circulating capital, number of dairy cows. All these inputs are presumed to be fixed in short run. Due to limited data, variable inputs are not explicitly accounted. Descriptive statistics of the sample data are presented in Table 1.

{Table 1}

The estimates of internal transaction costs are very sensitive to the composition of vectors $\mathbf{x}$ and $\mathbf{y}$. In this regard, the set of constraints in model (7) that describes a particular set of resources manifests a certain convention about measuring internal transaction costs. Such agreement ascertains which costs should only be accounted as internal transaction costs. Particularly, the estimates obtained by the instrumentality of (7) assume that internal transaction costs are the costs of getting over any actually existing constraint *that is not explicitly present* in the model (7) but still affects the actual netput allocation. So, if one desires to exclude the constraint from a list of sources of internal transaction costs, the right way to do so is to implement this constraint in the empirical model.

The year 2006 data of Registry of large and medium farms located in Moscow oblast are employed for the purpose of estimation. The source of these data is State statistical committee of Russian Federation. The studied sample includes the farms that have:

- nonzero sales;

- nonzero dairy cows population;
- no pigs or poultry;
- at least 50% of revenue received from sales of dairy milk;
- at least 0,5 ha of farmland per dairy cow;
- less than 14 tons of sold milk per dairy cow.

The purpose of these conditions are to decrease heterogeneity of the sample, exclude resellers and farms that are about to go bankrupts.

Additionally, the initial run of the model was used to identify farms that are not technically linked with others. Particularly, their technology is never used as a reference technology and they do not use technologies of other farms as reference technologies. These farms are also removed from the sample. The number of farms remaining in the sample after applying all these filters is 89.

4 RESULTS

On average, the estimated internal transaction costs of outputs on the studied farms are:

- 8.86 thousand roubles per ton of dairy milk (111% to average milk price);
- 2.90 roubles per rouble of other animal production;
- 1.75 roubles per rouble of crop production.

The lowest relative transaction costs are those of dairy milk. This matches the theoretical consideration that the relative internal transaction costs of the major output are expected to be the lowest. All the three estimates exceed the corresponding output prices, indicating very heavy burden of internal transaction costs. Deeper analysis shows that this conclusion should be limited to a relatively small subset of farms where internal transaction costs of an output are larger than its price. In case of milk there are 23 such farms (25.8% of the sample). In case of other animal production their number is 35 (39.3% of the sample). In case of crop production the number of such farms is also 35.

Correlation between farm-specific internal transaction costs of the three outputs is dissimilar. Spearman rank correlation between the internal transaction costs of milk and of other animal production is 0.616. In case of milk and crop production it is 0.422. Both values significantly differ from zero at α=0,001. However, the internal transaction costs of other animal production and of crop production display Spearman rank correlation amounting only to 0.154, which does not significantly differ from zero even at α=0.1. This is likely due to the composi-

tion of the sample. Milk is the major output for all the farms in the sample, so the factors forming its transaction costs are likely to affect transaction costs of secondary outputs as well.

The farm-specific values of internal transaction costs of milk are distributed asymmetrically. The sample average is larger than the average transaction costs in the fourth farm group (of five) on internal transaction costs of milk (Table 2).

{Table 2}

The majority of farms are not likely to bear actual expenses due to such large internal transaction costs. Instead they can be reasonably presumed to avoid these costs by not optimizing output allocation. Such behaviour is theoretically expected in case (b) described in Section 2, when a farm is located inside the range between ($\mathbf{x}_0$, $\mathbf{y}_0$) and ($\mathbf{x}_1$, $\mathbf{y}_1$). However, a part of internal transaction costs is still likely to be expended. Such expenses can be one of the reasons for large losses that the farms in the sample are characterized by.

From Table 3 it follows that the existing relations between internal transaction costs of milk and farm characteristics are, as a rule, non-linear. Particularly, Kruskal-Wallis test, a non-parametric replacement for analysis of variance, rejects the hypothesis that the group number is not a significant source of differences in median dairy cows population (at α=0.1). Nevertheless, Spearman rank correlation between the internal transaction costs of milk and number of dairy cows is not significantly different from zero. The average number of cows is the largest in group 2, followed by groups 3, 5, 1 and 4. It can be concluded that the farms having the largest herds tend (rather weakly) to have not very high internal transaction costs of milk, ranging from 1.2 to 2.5 thousand roubles per ton. This amounts to 15 to 30% of farm-gate milk price. Farms having relatively small herds are more likely to have either very low or very high internal transaction costs of milk.

{Table 3}

Theoretically, when production function constraints are not active, farms are expected to stop seeking better output allocation when marginal internal transaction costs per unit of each output are equal to their price. This expectation holds in the studied sample. However, another theoretical prediction in case of inactivity of production function constraints is that this correspondence should be valid for any sub-sample. As a result:

- Kruskal-Wallis test should reject absence of difference in median values of farm-gate milk prices (this holds at α=0.05);
- Spearman rank correlation should be significantly positive.

Contrarily to this prediction, Spearman rank correlation is found to be negative and to significantly differ from zero at α=0.05. Hence, it should be concluded that there is a sufficiently large number of cases when, despite presence of high transaction costs, the production function constraints significantly influence the amount of milk output. This affects the observed relation between farm specific milk prices and internal transaction costs of this product.

Although farms with larger internal transaction costs of milk tend, in general, to be characterized with lower milk prices, this correspondence is weak and uneven. There is a price minimum in group 3. In the group 4 transaction costs amount to the level of milk price (ranging 60 to 125% of it), meanwhile the milk price does not significantly differ from minimum in group 3. It is likely that this group is the most probable place for farms whose technical constraints determine their milk output to a minimal extent. This happens due to large internal transaction costs, which in fact make output allocation management impossible.

The institutional theory of a firm concludes that internal transaction costs must positively correlate to farm size. This study provides a very weak support of this conclusion for the case of the studied sample. Neither herd size nor production costs display a monotonic relation to the internal transaction costs of milk. The only size indicator that positively correlates (in terms of ranks) with the internal transaction costs of milk is revenue. The Spearman rank correlation is low and significantly differs from zero only at α=0.1. The only reliable conclusion can be made that larger farm size does not decrease the internal transaction costs of milk.

Pairwise Kolmogorov-Smirnov test concludes about significance of differences between two groups. Table 3 reports its results with respect to the pair of the most contrasting groups on internal transaction costs of milk. The statistically significant difference is found only in cases of gross revenue and farm-gate milk price. This result conforms to conclusions about presence of statistically significant rank correlation that are made above.

{Table 4}

Analysis of internal transaction costs of other animal production and of crop production is restricted by missing data on prices. However, the reduced costs of constraints binding these outputs to their observed amounts can be interpreted as ratios of internal transaction costs to output prices. This allows comparison of internal transaction costs burden among outputs.

From Table 4 it follows that the internal transaction costs of other animal production take even larger share in its price that it is estimated for milk. These shares are 0.10 compared to 0.07 in the lower groups, 11.27 versus 3.90 in the upper groups and 2.90 versus 1.11 on aver-

age. Like in case of milk, the internal transaction costs of other animal products are asymmetrically distributed among farms. Their average value falls into the range of group 5.

{Table 5}

Like in case of milk, internal transaction costs of other animal production depend on the number of dairy cows. However, the nature of this dependence is different: in case of milk it only could be discovered by means of Kruskal-Wallis test while in case of other animal production Spearman's rank correlation significantly differs from zero at α=0.05 (Table 5). In contrast to the predictions of institutional theory, larger transaction costs are associated with smaller herds. However, this result is not shown up in correlation of internal transaction costs of other animal production to other available farm size indicators. In this respect, the confusing relation to herd size is rather due to differences in management practices between farms having different livestock number than due to an impact of farm size itself.

{Table 6}

{Table 7}

Relative internal transaction costs of crop production (Table 6) are close to those of other animal production (Table 4) and larger than in case of milk. These costs are driven by amount of crop sales (Table 7). As a consequence, the rank correlation between gross revenue and internal transaction costs of crop production is also significant. These dependencies are mainly caused by the fact that many small dairy farms do not produce marketable crops at all. Nevertheless, neither production costs nor profitability significantly correlate to the internal transaction costs of crop production.

5 DISCUSSION AND OUTLOOK

The study reported in this paper concentrates on testing the capacity of the developed methodology and validating the results against theoretical expectations. This section outlines a range of practical applications of estimating internal transaction costs.

An important extension of this study, which is planned for future, is to supplement estimations of internal transaction costs by estimating allocative efficiency on the base of the same set and the common methodological framework. This extension hedges from possible misinterpretation of high internal transaction costs. Providing that farm outputs are allocated closely to optima, there is no reason to take these costs into account. This study is not affected by this problem, because large losses of the sample farms make non-optimal output allocation evident.

One of the possible casual factors of large internal transaction costs in the studied sample is that owners of a farm business are not motivated to either invest or to attract investors to cut these costs. As investment rating of Russian agriculture is generally low in comparison to other investment opportunities (Zeldner, 2005), sufficient investments in this specific field are also unlikely. Given input and output prices, available technologies, weather conditions and labour force quality, the investors do not expect high return on any investment in agriculture. Their negative attitude spans investments in improving management.

This problem is likely to slow down positive impact of economic reforms, to cause skeptic attitude of both rural population and farm managers with respect to the transitional process as a whole. So, studies on interrelation between investments in developing human capital, modern management systems, reengineering and improving decision making process and the level of internal transaction costs are a promising extension of this research.

Another casual factor of large internal transaction costs that should be tested for significance is that the existing agricultural policies tend to hedge Russian farms from foreign competition. In this situation both owners and management of the farms lack motivation to cut internal transaction costs. Regardless to this particular reason, competition in the regional agriculture needs to be improved. However, the current situation is such that a stronger competition can cause bankruptcy to the whole dairy milk sector rather than to a few outsiders. Each step in improving competition should be undertaken after a thorough analysis.

A vulnerability of the theoretical model (4) is that in practice decision makers do not know internal transaction costs. Hence, they cannot be expected to behave in a precise concordance to this model. In this respect, the estimates obtained on the base of this theoretical framework recover the transaction costs that are expected by decision makers rather than the true transaction costs. So, the recommendations to avoid them could appear to be redundant, as the actual problem may rest on the human factor. As a conclusion, formal estimations of internal transaction costs should be combined with case studies and questionnaires to be fully credible, unless the purpose of a study is to reject significance of these costs.

6 Conclusions

This study reveals high internal transaction costs on dairy corporate farms located in Moscow oblast of Russia. Only in 40% of the sample farms the internal transaction costs of milk are less than 1/3 of its sales price. In a quarter of the sample farms they exceed the price.

The farms do not necessarily bear these costs and account them as a part of production costs. It is more likely that they avoid such expenditures fully or partially. This hampers accessing optimal allocation of marketable output and causes (together with other factors) widespread of unprofitable operations.

Presence of high internal transaction costs conforms to the earlier study (Svetlov and Hockmann, 2007), which concluded that the allocative inefficiency dominates over other sources of inefficiency of corporate farms located in Moscow oblast.

In presence of high transaction costs price signals from the market are not the foreground factor of market output allocation. They are not able to drive farm business to seek the most efficient use of the available production capacity and to compete in the art of reaching the highest performance. Hence, the competitive market fails to play the role it is intended to play, diminishing the value of economic reforms in agriculture.

This may explain the current trend of institutional development in Moscow oblast, which is characterized by increasing role of non-market regulators of agricultural production. Political force and external financing increasingly influence agricultural business. Implementation of the national project ‘Development of agro-industrial complex’ in 2006-2007 established a new phase in the progress of non-market regulations.

The theoretically predicted positive correlation between farm size and internal transaction costs is not shown up, likely due to including only corporate farms in the sample. It is possible that comparison of internal transaction costs among farms of different types (corporate farms, family farms and household plots) will discover this dependence.

The outcome of this study supports the position that any way to reincarnate regional agriculture as a competitive business (if exists) should consider making investments to lower the internal transaction costs. In particular, the projects aimed at improving farm organization, introducing less expensive and more efficient management, training existing staff and employing trained staff are necessary to be implemented widely. Stimulating such projects should be considered as a top priority of agricultural policy in the studied oblast, which predefines returns from any other investment in the rural economy.

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Tables

Table 1: Descriptive statistics of the source data

Variables	Minimum	Mean	Maximum	Standard deviation
Sales of milk, tons	2126	25800	88064	18093
Revenue from sales, thousand roubles:				
milk	1641	20977	68710	15228
other animal production	307	3849	10694	2633
crop production	0	2464	25025	3658
Arable land, ha	0	2277	6634	1510
Hayland and grassland, ha	0	553	2815	497
Workers	5	105	308	62.0
Depreciation, thousand roubles	0	1962	15030	2205
Total costs, thousand roubles	2019	39297	161341	25766
Cows	81	607	2372	389

By the end of 2006, €1=34.70 roubles.
Source: author's calculations.

Table 2: Internal transaction costs of milk on dairy corporate farms located in Moscow oblast (year 2006), thousand roubles per ton

Group number	Range of internal transaction costs of milk	Number of farms	Average internal transaction costs of milk
1	0.1…1.2	17	0.6
2	1.2…2.5	18	2.0
3	2.5…4.8	18	3.5
4	4.8…9.5	18	6.9
5	9.5…76.6	18	31.0
Whole sample	0.1…76.6	89	8.86

By the end of 2006, €1=34.70 roubles.
Source: author's calculations.

Table 3: Relation between milk transaction costs and farm characteristics (year 2006)

Group number	Number of dairy cows	Production costs, thousand roubles*	Gross revenue, thousand roubles**	Profitability***, %	Milk price, thousand roubles per ton
1	512	34456	20467	-13.5	8.55
2	811	45501	31378	-12.7	8.25
3	539	34523	22061	-10.9	7.50
4	542	36899	27351	-0.4	7.66
5	626	44837	31805	-8.5	7.95
Whole sample	607	39297	26681	-9.2	7.98
Kruskal-Wallis *p*	*0.0905*	0.1718	0.1271	0.3760	**0.0168**
Pairwise Kolmogorov-Smirnov *p* for groups 1 and 5.	>.1	>.1	**<0.025**	>.1	**<0.025**
Spearman rank correlation to internal transaction costs of milk	-0.0487	0.1512	*0.1987*	0.1211	**-0.2716**
Significance of Spearman rank correlation	-0.6504	0.1572	*0.0619*	0.2582	**-0.0100**

* Depreciation is not included.

** Only sales of agricultural production are accounted.

*** Gross margin to costs ratio (depreciation is accounted). Only sales of agricultural production are accounted.

By the end of 2006, €1=34.70 roubles.

Bold values are significantly different from zero at α=0.05. Italic values are significantly different from zero at α=0.1.

Source: author's calculations.

Table 4: Internal transaction costs of animal production (excluding milk) on dairy corporate farms located in Moscow oblast (year 2006), roubles per rouble of revenue

Group number	Range of internal transaction costs of other animal production	Number of farms	Average internal transaction costs of other animal production
1	0.00…0.25	17	0.10
2	0.25…0.50	18	0.34
3	0.50…0.96	18	0.78
4	0.96…2.75	18	1.86
5	2.75…33.5	18	11.27
Whole sample	0.00…33.5	89	2.90

By the end of 2006, €1=34.70 roubles.

Source: author's calculations.

Table 5: Relation between animal production (excluding milk) transaction costs and farm characteristics (year 2006)

Group number	Number of dairy cows	Production costs, thousand roubles*	Gross revenue, thousand roubles**	Profitability***, %
1	590	43206	26513	-6.9
2	758	41147	28723	-5.5
3	576	32153	22556	-8.5
4	536	31526	21011	-15.4
5	576	48671	34595	-9.4
Whole sample	607	39297	26681	-9.2
Spearman rank correlation to internal transaction costs of other animal production	**-0.2115**	0.0470	0.0790	-0.0122
Significance of Spearman rank correlation	**-0.0467**	0.6621	0.4618	-0.9097

* Depreciation is not included.

** Only sales of agricultural production are accounted.

*** Gross margin to costs ratio (depreciation is accounted). Only sales of agricultural production are accounted.

By the end of 2006, €1=34.70 roubles.

Bold values are significantly different from zero at α=0.05.

Source: author's calculations.

Table 6: Internal transaction costs of crop production on dairy corporate farms located in Moscow oblast (year 2006), roubles per rouble of revenue

Group number	Range of internal transaction costs of crop production	Number of farms	Average internal transaction costs of crop production
1	no crop output	22	—
2	0.005…0.30	13	0.17
3	0.30…0.90	18	0.56
4	0.90…2.00	18	1.35
5	2.00…16.6	18	6.61
Whole sample	0.005…16.6	89	2.32

By the end of 2006, €1=34.70 roubles.
Source: author's calculations.

Table 7: Relation between crop production transaction costs and farm characteristics (year 2006)

Group number	Sales of crop production, thousand roubles	Production costs, thousand roubles*	Gross revenue, thousand roubles**	Profitability***, %
1	0	26088	18378	-13.9
2	1677	53756	31471	-8.4
3	1489	41594	27893	-11.0
4	1733	41365	28057	-8.6
5	4738	40634	30783	-2.6
Whole sample	2464	39297	26681	-9.2
Spearman rank correlation to internal transaction costs of other animal production	**0.5845**	0.1913	**0.2094**	0.175562
Significance of Spearman rank correlation	**0.0000**	0.0725	**0.0489**	0.094143

* Depreciation is not included.
** Only sales of agricultural production are accounted.
*** Gross margin to costs ratio (depreciation is accounted). Only sales of agricultural production are accounted.
By the end of 2006, €1=34.70 roubles.
Bold values are significantly different from zero at α=0.05.
Source: author's calculations.